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Large Hadron Collider
Magnet Division Procedure

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Title: D2/D4 Cold Mass Assembly

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1 Scope:

This specification describes the procedure for end volume installation, and auxiliary test pipe installation on the LHC D2/D4 Dipole Cold Mass Assembly.

2 Applicable Documents:

The following documents, of the issue in effect at the time of release for manufacture, form a part of this procedure to the extent specified herein:

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
LHC-MAG-R-1038	LHC Twist Check & Fiducial Survey

BNL Drawings:

14010340	D2 Dipole Cold Mass Assy.
14010492	D4 Dipole Cold Mass Assy

3 Requirements:

Assembly work shall be done in accordance with the drawings and parts lists, and the installation and welding sequence described below.

All welding shall be performed by welders qualified in accordance with ASME Section IX. The welding parameters shall be set in accordance with those specified during welding process development.

3.1 Material/Equipment

25-1782.02-5 LHC Cold Mass Lifting Beam
25-1784.01-5 LHC Weld Rotator Assembly

3.2 Safety Precautions

3.2.1 Operators shall be trained by their cognizant technical supervisor and qualified in the operation of the welding equipment.

3.2.2 No welding shall take place unless all welding screens are in place around the welding station, and all personnel not directly involved with the welding process are outside the screens. Any personnel inside the screens shall wear protective gear to prevent eye injury, and shall be clothed to prevent burns caused by intense ultra-violet light.

3.2.3 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be trained and certified in the use of the appropriate lifting device by the Cognizant Engineer or Technical Supervisor.

3.3 Procedure

3.3.1 End Volume Welding

3.3.1.1 Verify that all necessary electrical tests were completed after electro/mechanical assembly.

3.3.1.2 Using 25-1782.02-5, crane lift the cold mass and place it on the weld station rollers with the adapter rings.

3.3.1.3 Trim beam tubes to the dimensions shown on the assembly drawing.

3.3.1.4 Mount the lead end volume on the magnet. Thread all the instrumentation wires/cables through the lower left port in the end volume as shown on the assembly drawing.

3.3.1.5 Tack weld the end volume in place using six equally spaced welds approximately 1/2" long using filler wire (P/N 12010441-03).

3.3.1.6 Complete the welding of the end volume by manual TIG welding using filler wire (P/N 12010441-03).

3.3.1.7 Repeat steps 3.3.1.4 through 3.3.1.6 for the non-lead end volume.

3.3.1.8 Weld the beam tubes to the end volume stubs by manual TIG welding using filler wire (P/N 12010441-03).

3.3.2 Auxiliary Test Pipe Installation

3.3.2.1 Weld the pipe support brackets to the cold mass by TIG welding using filler wire (12010441-03) as shown on the assembly drawing.

3.3.3 Instrumentation Feed-Thru Installation

3.3.3.1 Thread the instrumentation wire bundle thru the IFS assembly and temporarily support the assembly.

3.3.3.2 Perform electrical testing per Appendix 1. Record results in traveler.

3.3.3.3 Position the assembly so that the warm head is approximately 70^0 clockwise from vertical.

3.3.3.4 Position the cold head to approximately 2" from the end volume flange. This will allow some flexibility to move the tube as bends are being made.

3.3.3.5 Using a 5/8" tubing bender, bend the IFS tube as shown on the assembly drawing.

3.3.3.6 When all the bends are complete and the warm head is in the proper position, complete the weld of the cold head to the end volume flange.

3.3.3.7 Perform electrical testing per Appendix 1. Record results in traveler.

3.3.3.8 Temporarily secure the flex line and warm head to the cold mass.

3.3.4 Inspect Welds

3.3.4.1 Call for a certified weld inspector to inspect and sign off on all welds.

3.3.4.2 Measure cold mass straightness and sag per LHC-MAG-R-1038 Section, 4.2.1-4.2.5. Cognizant engineer to verify straightness and sag within drawing requirements and sign-off traveler "OK to proceed".

3.3.4.3 Establish the vertical distance from the corners at the bottom of each cradle to the lamination survey flats above the cradle.

3.3.4.4 Establish cold mass fiducial locations LHC-MAG-R-1038, Section 4.2.6 - 4.2.9.

3.3.4.5 Position dial indicators at each end of the shell and zero the indicators.

3.3.4.6 Weld on the ten cover discs over the shell holes. Weld the discs using a crisscross pattern, alternately welding one disc, then the opposite disc, etc., moving back and forth along the length of the cold mass. Use the same pattern from cold mass to cold mass.

3.3.4.7 Weld stripe the shell at a position just outboard of the cradles to bring the ends of the cold mass back into position (i.e. indicators back to zero).

3.3.4.8 Perform optical survey of the end volume fiducials and the dings in the shell at each end to verify that the cold mass is still within tolerance for straightness and sag.

3.3.4.9 Place the cold mass on its support posts and measure the distance between the bottom of the post (top of table) and the bottom of the cradle. Take four measurements on each cradle, at locations 90^0 apart. Record results in traveler and calculate average. Label each post with cold mass serial number and post position.

3.3.4.10 Mark finished assembly with part number and serial number as shown on the assembly drawing.

4 Quality Assurance Provision:

4.1 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.

4.2 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

4.3 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5 Preparation for Delivery:

N/A

Appendix 1 - Electrical tests

1. Connect both beam tubes, all quench protection resistors & iron to each other and to ground. Connect all coils together and perform 5 kV Hypot between coils and ground per RHIC-MAG-R-7242 and RHIC-MAG-R-7243.

NOTE

The leakage current must be less than 50 µa.

2. Perform resistance test between normal and redundant voltage tap wire at each point. Resistance to be 320Ω - 480Ω.

3. Perform resistance test on each of two Quench Protection Resistor circuits.

4. Connect both beam tubes, all coils & iron to each other and to ground. Perform 5kV Hypot between each of two quench protection resistor circuits and ground per RHIC-MAG-R-7242.

NOTE

The leakage current must be less than 50 µa.

5. Connect both beam tubes, all coils, iron & quench protection resistors to each other and to ground. Perform 2kV Hypot between each warm-up heater circuit and ground per RHIC-MAG-R-7242.

6. Perform resistance test on each of two warm-up heater circuits. Resistance should be 95Ω-105Ω.

NOTE

The leakage current must be less than 50 µa.

7. Perform DC resistance tests per RHIC-MAG-R-7320 to measure voltage drops across the entire magnet winding and the voltage drop across each individual coil. Perform measurements using regular and redundant voltage taps individually.

8. Perform resistance check of Level Probes as noted in LHC-MAG-R-1051. Record results in traveler.

9. Perform resistance check of Temperature Sensors as noted in LHC-MAG-R-1051. Record results in traveler.